



Bioterrorism and Health System Preparedness



Addressing Surge Capacity in a Mass Casualty Event

The Agency for Healthcare Research and Quality (AHRQ) is the lead agency charged with supporting research designed to improve the quality of health care, reduce its cost, address patient safety and medical errors, and broaden access to essential services. AHRQ sponsors and conducts research that provides evidence-based information on health care outcomes; quality; and cost, use, and access.

The information helps health care decisionmakers—patients and clinicians, health system leaders, and policymakers—make more informed decisions and improve the quality of health care services.

Introduction

Surge capacity is a health care system's ability to expand quickly beyond normal services to meet an increased demand for medical care in the event of bioterrorism or other large-scale public health emergencies.

A bioterrorist attack or other large-scale public health emergency has the potential to result in great numbers of human casualties. Substantial work has been done throughout the country at local, regional, State, and Federal levels to improve health system preparedness, and many health care organizations and systems have developed surge capacity and other medical care preparedness plans. Planning for a mass casualty event should also address what can be done outside the traditional health care system to cope with a surge in patient flow before, during, and after an event.

In 2004, the Agency for Healthcare Research and Quality (AHRQ) expanded its Bioterrorism Preparedness Research portfolio to include several projects that focus on surge capacity issues. Consistent with that focus, AHRQ sponsored three Web conferences on surge capacity and health system preparedness. The first dealt with education and training; the second with facilities and equipment; and the third in the series, held on October 26, 2004, examined some of the ways resources might be deployed in response to a mass casualty event. This issue brief summarizes this third Web conference.

Four panelists made presentations:

- ▲ Robert Claypool, M.D., Deputy Chief Medical Officer, Office of the Assistant Secretary for Public Health and Emergency Preparedness, U.S. Department of Health and Human Services
- ▲ Nathaniel Hupert, M.D., Assistant Professor of Public Health and Medicine, Weill Medical College of Cornell University



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- ▲ Michael Shannon, M.D., Director of the Center for Biopreparedness and Chief of the Hospital's Emergency Medicine Division, Children's Hospital Boston
- ▲ Gregory Bogdan, Ph.D., Research Director and Medical Toxicology Coordinator, Rocky Mountain Poison and Drug Center, Denver Health

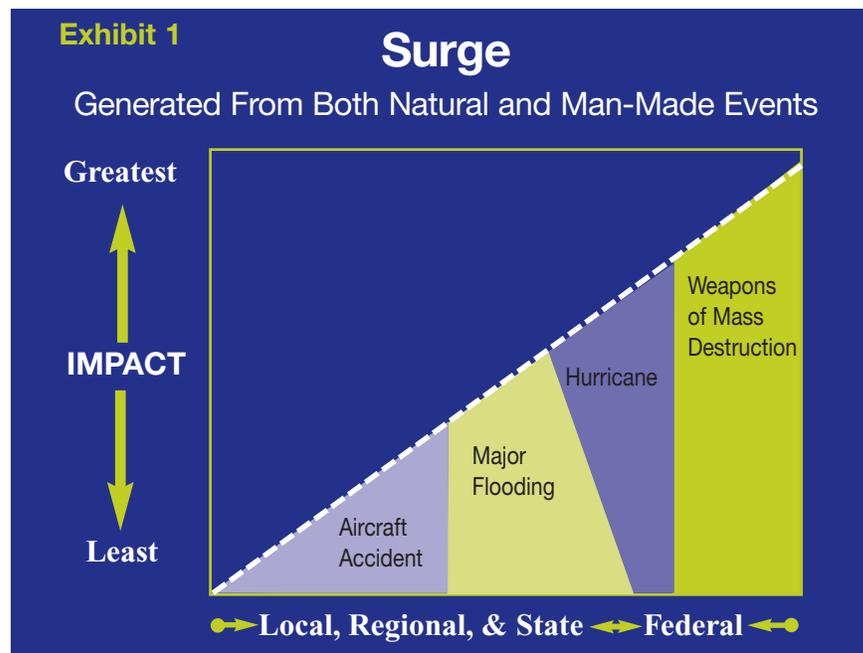
Dr. Robert Claypool discussed the role of the Department of Health and Human Services (HHS) in developing surge capacity as part of the National Response Plan and described an initiative to develop Public Health Service Contingency Stations as alternative care facilities. Dr. Nathaniel Hupert presented models of surge capacity and pre-hospital treatment in a surge event. Dr. Michael Shannon described the challenges of treating large numbers of children, and laid out the main steps in creating a school-based emergency response plan. Dr. Gregory Bogdan explained the critical role that risk and crisis communication play in reducing the number of people who might seek health care during a large-scale public health emergency. A short question and answer period followed the presentations by the panelists.

Role of HHS in Achieving Surge Capacity Capabilities

Dr. Robert Claypool began his presentation by saying that the definition of surge capacity should include three factors: the volume of cases, time as a function of the volume of cases, and the complexity of cases involved. He explained that hospitals deal with surge fairly regularly, when they go on bypass or have to send patients to other places. In dealing with weapons of mass destruction,

however, the health system is at risk of being severely stressed and so inelastic that at least two things might happen. First, access to care, or having care rendered, might become compromised. Second, the quality or the standards of care might have to change to meet the greatest good.

for resources comes at a time when the economic realities of the health care system in the United States are reflected in the closing of hospitals and the reduction of bed availability. Within HHS, the Health Resources and Services Administration, the Centers for Disease Control and



Expanding upon the three-factor definition of surge, Dr. Claypool pointed out that surge doesn't necessarily have to do with large volumes of patients. A case in point is the severe acute respiratory syndrome epidemic that recently occurred in Canada, where a relatively small number of patients severely challenged the health care delivery capability in Toronto. Burns are another example of ways in which relatively few cases can severely stress health system capability.

To meet surge capacity needs, the Federal Government is currently developing the National Response Plan. Within that plan, HHS will lead the emergency support function that deals with health and medical issues. The capacity to provide health care represents the most resource-intensive component of the plan, but the need

Prevention, and AHRQ are all looking at different ways, through grant and cooperative agreement programs, to increase bed capacity in our country.

In addition, a collaborative effort between HHS, the Department of Homeland Security, the Department of Defense, and the Department of Veterans Affairs is developing a program known as the Public Health Service Contingency Stations (PHS-CS). This program borrows a concept from the Civil Defense System of the 1950s and 1960s known as Packaged Disaster Hospitals. These were deployable hospitals that could be constituted to support care in the event of a nuclear attack. At the peak of that program, 2,000 Packaged Disaster Hospitals were stationed across the country, with each providing 200 to 250 beds.



The PHS-CS will have the capability of a general medical/surgical ward. They will not have an operating room, an Intensive Care Unit, or an Emergency Room. In the initial stage, they will not have a triage area. Each will be packaged in 50-bed increments, and could be deployed in 50-bed increments up to 250 beds for each station. Each unit will also contain medical supplies and a pharmaceutical package. Four contingency stations have been purchased in 2004. They are designed to be used in a shelter of opportunity; i.e., they would go into a facility such as a high school gymnasium or an armory.

In the future, the PHS-CS program will include modules for burn/surgical treatment, acute treatment, isolation, triage, and decontamination. The top priorities are the capability to treat burns and the development of a deployable isolation module. The burn module is especially important for bioterrorism preparedness because vesicants that might be used in a chemical attack produce lesions that mimic burns. The deployable isolation module will be a self-contained, free-standing unit; that is, it will not require retrofitting of an existing facility.

Facilities, of course, will require health care personnel to staff them. HHS is exploring ways to train health care professionals to perform multiple functions. A cardio-pulmonary thoracic technician, for example, might be cross-trained to support dialysis care. A current AHRQ project is to develop, implement, and test a model to cross-train health care personnel to provide ventilator support. The project will then determine the applicability of the cross-training model for other required functions.

Modeling Surge Capacity

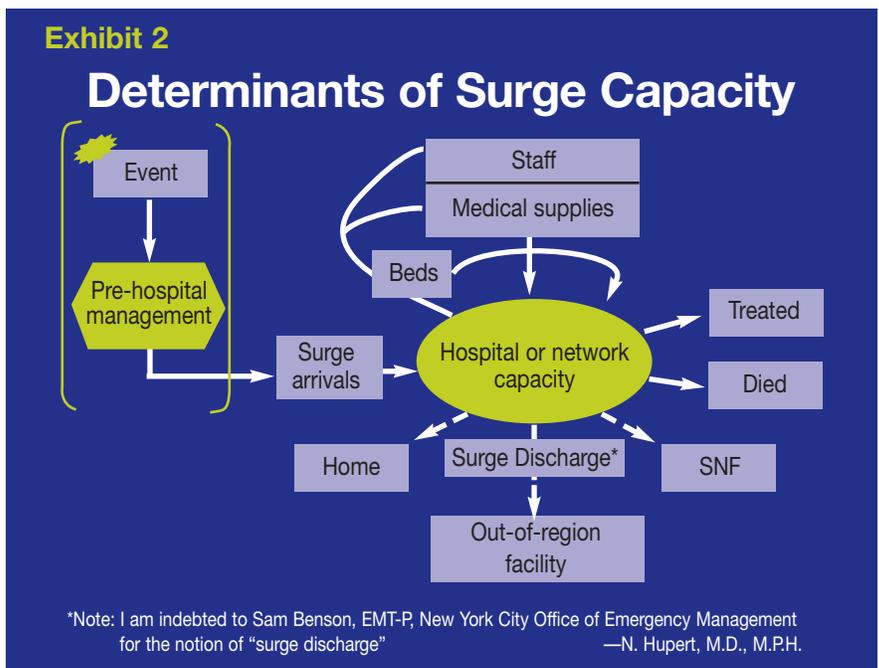
Dr. Nathaniel Hupert explained that the value of modeling surge capacity is to

help us question our common assumptions about what it would take to respond to a large mass casualty incident. Furthermore, modeling helps us analyze the variables involved (time, numbers of patients, and so on) in quantitative terms so that concrete numbers can be generated to use in planning.

Under a project funded by AHRQ, Dr. Hupert and his colleagues have analyzed the determinants of surge capacity as illustrated in Exhibit 2. The first is surge arrivals at the hospital, which is a function of (1) the number of people who have been exposed or involved in an event, and (2) the possible treatment of patients outside the hospital, or pre-hospital management. The number of surge arrivals will be greater or fewer, depending on how many patients can be accommodated by pre-hospital management. In the event of a

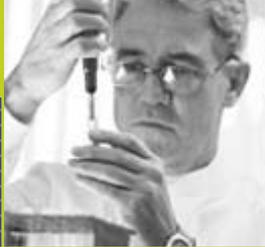
Once patients arrive at the hospital or network of health care facilities (such as clinics, rehabilitation facilities, or long-term care facilities), the second determinant of surge capacity is the **availability of hospital resources**. The number of patients who can be treated during a surge event depends on such factors as the number of staff, medical supplies, and the circulation of beds. The circulation of beds, in turn, depends to some extent on the third determinant, which is **surge discharge**.

The concept of surge discharge is based on Dr. Hupert's work with Sam Benson, AEMT-P, of the New York City Office of Emergency Management. The concept is that some patients who were already in the hospital at the time of the event may be transferred to other facilities, thus making space available for surge arrivals. Some percentage of arriving patients also can be treated and discharged. Examples of places patients



biological attack or an outbreak of an infectious disease, for example, pre-hospital management would include the dispensing of antibiotics or vaccines to as many people as possible without admitting them to the hospital.

can go if they are ready for discharge from the hospital include home, perhaps with skilled nursing care available at home; an out-of-region facility; or a special, skilled nursing facility. Dr. Hupert cited the



example of his own hospital's experience on September 11 and 12, 2001, when New York Presbyterian Hospital was able to discharge approximately 20 percent of its patients to be able to treat arriving casualties.

Dr. Hupert described a second model he and his colleagues have developed for pre-hospital management in response to a biological attack or an outbreak of an infectious disease. A simple, conceptual model is presented in Exhibit 3. The model shows that **degree of protection** is a function of how long it takes the community to respond to the attack or outbreak (**delay in reaction**) and the time required to administer medication to the affected population (**time needed to protect community**). Another way to think about this is the time that elapses before the first pill is dispensed, which is the delay, and the time that passes until the last pill is dispensed, which is the time needed for the entire campaign. The quicker the community can respond, and the quicker the community can administer medication, the lower the potential patient load on community hospitals will be.

Dr. Hupert and his colleagues have translated this conceptual model into a spreadsheet version that calculates outcomes for pre-hospital anthrax prophylaxis. The formulas in the spreadsheet start with consensus estimates of how inhalational anthrax might act if there were an outdoor release of anthrax spores, and incorporate a set of assumptions about detection, effectiveness of treatment, and patient compliance with medication. Planners can enter numbers into the spreadsheet to generate the percentage of exposed individuals who do not get sick because they receive antibiotics in time. The percentage is highest if the community responds quickly and is able to dispense antibiotics to the affected population in a matter of a few days. That percentage declines over time, of course, and those people who subsequently get sick create an increase in the numbers of patients who must be admitted to the hospital. Thus, the model illustrates the importance of pre-hospital treatment in reducing hospital surge.

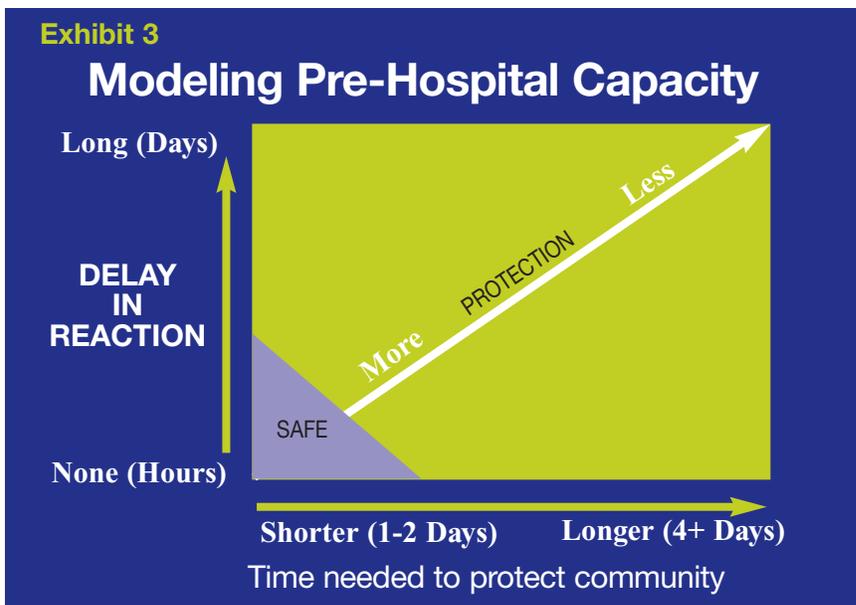
Applied differently, the model can also predict when surge is most likely to occur. The modeling shows that

planners can take one exposure scenario, play it out in a number of different ways, and wind up with very different daily and total casualty loads, depending upon how the community has been organized and how successful the community is in responding to that event.

The components a community must have in place to prepare for mass prophylaxis are explained in detail in Dr. Hupert's *Community-Based Mass Prophylaxis: A Planning Guide for Public Health Preparedness*. The *Planning Guide* was also developed under an AHRQ grant and is available on the Bioterrorism Preparedness section of the AHRQ Web site (<http://www.ahrq.gov/browse/bioterbr.htm>). A companion piece on the AHRQ Web site, the *Bioterrorism and Epidemic Outbreak Response Model (BERM)*, is an interactive database that makes it possible for planners to calculate the actual numbers of facilities and staff they will need in their communities to prepare for mass prophylaxis (<http://www.ahrq.gov/research/biomodel.htm>). Dr. Hupert and his colleagues are developing a Web-based version of the spreadsheet that calculates outcomes for pre-hospital anthrax prophylaxis, the *Regional Hospital Caseload Calculator*, which will also be made available on the AHRQ Web site.

Addressing Pediatric and School-Based Surge Capacity

Dr. Shannon and the Center for Biopreparedness at Children's Hospital Boston have developed several pediatric-focused tools under AHRQ contracts and are developing several protocols for mass casualty events involving children. Before discussing those protocols he described some of the key issues in planning for surge capacity involving children.





Dr. Shannon said, in creating surge capacity plans for children, it is important to keep in mind and consider every potential type of disaster, terrorist or otherwise; this means that planning should be based on the all-hazards approach. In addition, surge capacity planning should include schools, with two contingencies in mind: one is the school as a specific target of a terrorist event or as the scene of a disaster of some type. The second is a community disaster that occurs while school is in session.

Key Challenges in Consequence Management

Every aspect of consequence management will be challenged in an incident that involves large numbers of children:

- ▲ All of the first responders—emergency medical services staff, firefighters, and police officers—are going to have a difficult time when they are taking care of many injured or traumatized children.
- ▲ If an event involves an infectious agent or patients who are contaminated with a chemical agent, triage and decontamination must take place outside the hospital to protect the hospital campus from infection or contamination. This will require establishing control of all points of ingress and egress.
- ▲ Decontamination teams will be challenged by having to take care of frightened children or children who are very small, particularly while the teams are wearing cumbersome personal protective equipment.
- ▲ The challenge of decontaminating children will be compounded by inclement weather, and especially cold weather.

- ▲ If the event requires mass distribution of antibiotics, antidotes, or vaccines, health care workers should expect the triage and screening of a child to take twice as long as it would for an adult, because children will not be able to provide details of their medical history.
- ▲ General Emergency Departments—those that take care of mixed populations, children as well as adults—are going to be challenged by having to treat very large numbers of children with limited amounts of pediatric supplies. Hospitals in general will be similarly challenged.
- ▲ There will be enormous needs in terms of mental health response and recovery, not only for children but also for parents and health care workers.

Special Needs of Children

Because children are different from adults, they need to be treated differently in a mass casualty event. In terms of a **biological event**, children have an immature immune system, which means that they are less able to resist some types of infections, thus leading to greater morbidity and mortality in children. In a **chemical event**, children are a challenge for anyone to assess, manage, and guide through decontamination. If there were a **radiological event**, children are much more susceptible to the consequences, particularly the development of cancer. If there were a **blast injury** of some type or any blunt trauma, treating large numbers of children in what Emergency Medicine calls the “golden hour of trauma” would be difficult. In an event involving **burns**, children have a greater likelihood of life-threatening fluid loss and susceptibility to infection.

The School Crisis Response Manual: Guiding Principles

Dr. Shannon and his colleagues are currently developing a protocol for collaboration between hospitals and schools to prepare and train for emergency response. Visits to school districts around the country have convinced him that guidelines are desperately needed to prepare for a school’s being the target of a terrorist event.

The main steps in creating a school-based emergency response plan are:

- ▲ Get a sense of the Principal’s level of understanding and his or her communication with local public health authorities.
- ▲ Work with school nurses to ensure there is a plan for taking the children’s medications with them during evacuation and relocation.
- ▲ Include a sheltering and/or a lock-down plan.
- ▲ Determine the best sites for sheltering or lock-down, based on an understanding of the unique architecture of the school, the location of the heating systems, routes of ingress and egress, and so on.
- ▲ Include after-school programs in the planning and identify the person who would be in charge.
- ▲ Integrate with existing plans; for example, with the evacuation and relocation plan for a fire drill.
- ▲ Take inclement or stormy weather into account.
- ▲ Conduct drills, including tabletop exercises with the key leadership of the school.



Protocols for Disaster Medical Assistance Teams and Emergency Departments

Dr. Shannon and his colleagues are also developing protocols for Disaster Medical Assistance Teams (DMAT) and Emergency Departments in response to a mass casualty incident involving children. DMATs are part of the National Disaster Medical System and have been in existence for some time. They are designed to respond to a disaster of any type. Of approximately 30 existing DMATs, however, only two are dedicated pediatric teams. More are needed; at the very least, the system should consider having these teams regionalized so that the site of the emergency can be reached more quickly if needed. In addition, existing DMAT teams should receive additional training in taking care of children.

The challenges Emergency Departments will face include:

- ▲ Having adequate number of pediatric supplies
- ▲ Having in place pediatric decontamination equipment and protocols
- ▲ Having developed an effective response plan to manage large numbers of children
- ▲ Having staff skilled at assessing young, non-verbal children
- ▲ Taking care of children while wearing personal protective equipment
- ▲ Creating systems for identifying, tracking, and reuniting children with their families
- ▲ Having identified the rational use of alternate sites for taking care of children, such as schools or neighborhood health centers
- ▲ Allocating resources to treat the “second wave” of patients

Dr. Shannon said schools and neighborhood health centers can be used to accommodate the “worried well” and to treat the “walking wounded” so that the Emergency Department can be reserved for those who really need immediate help. As was learned from the Sarin incident in Tokyo in 1995, the first wave of patients arriving at the hospital are able to get there on their own and are relatively healthy. The more seriously injured and ill have to be treated at the scene and transported to the hospital; they are the “second wave.”

The AHRQ products being developed by Children’s Hospital Boston are in various stages of completion. Their availability will be announced on the AHRQ Web site.

Addressing Surge Capacity Through Information Exchange

Dr. Bogdan explained that one of the key components of surge response is risk and crisis communication: getting out the appropriate messages to the public so they know what is going on and what is available to help them. This would reduce the number of people presenting to health care facilities who may not need to be seen—the “worried well”—which would allow hospital resources to be used most effectively to treat people who need these resources the most.

The challenges for communicating with the public during an emergency are illustrated by the findings of the Redefining Readiness Project from the Center for Advancement of Collaborative Strategies and Health (<http://www.caash.org>). According to this study, 60 percent of the public said they would not heed official instructions to get vaccinated during a smallpox outbreak, and 40 percent of

the public would not heed official instructions to shelter in place during a dirty bomb incident. The conclusion to be drawn is that people won’t necessarily accept and follow instructions, but want to decide for themselves what is best for their families. Call centers provide a mechanism for the public to ask their questions and express their concerns to enable them to make their own decisions.

The public needs to know general event information—who, what, where, when, and why—and they need to trust the source of the information. They want to find out how they can protect themselves and their families. They want to know what State and local health departments recommend and, if they have further needs, they want to be able to refer to the most appropriate agencies to take care of those needs. They also want help with making decisions. They want to know, based on their own circumstances, their own problems, and their own underlying medical conditions, what they should do next to take care of themselves and their families.

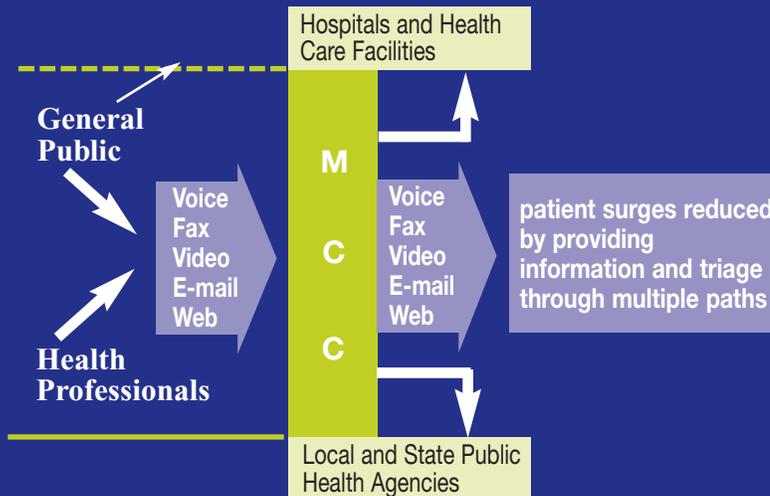
The “natural fits” to provide needed information are the Poison Control Centers that exist across the country; nurse advice lines, which many HMO agencies utilize; drug information centers; and public health agencies.

Exhibit 4 illustrates how a medical call center works. The general public and health care providers can contact these centers in a variety of ways, but the most common mode of communication is the telephone. Some callers will describe symptoms that require a visit to a health care facility for further evaluation, but many questions or concerns can be answered effectively over the telephone. In a surge event, the medical call center fulfills its purpose by reducing the number of patients who



Exhibit 4

How a Medical Call Center Works



seek care at a hospital or other health care facility, allowing those agencies to focus on helping those with the greatest need.

The Colorado Health Emergency Line for the Public, or CO-HELP, is a medical call center that has been in operation since January 2003. This service was created to provide a standardized, prepared response to health events in Colorado and to provide consistent and accurate information to callers. It was also designed to collect and maintain structured data that could help characterize events for future responses. The service was funded by the State Health Department to provide the capacity and the capability to adapt to emerging health threats.

CO-HELP refers users to the right agencies for further assistance. These include the State's poison control center, nurse advice lines, health care providers, and guidelines and protocols available from local and State health departments. CO-HELP's users include the general public, health care

providers, hospitals, clinics, health agencies, and schools. It was accessed, for example, by tourists who were planning to visit Colorado in 2003, when West Nile virus and influenza were concerns.

"The greatest benefit of using a medical call center is to be able to provide the public with a mechanism for one-on-one information exchange."

Dr. Bogdan and his colleagues developed the *Health Emergency Assistance Line and Triage Hub (HEALTH) Model* under a contract with AHRQ. The report describes how the Denver Health Medical Information Centers determined the requirements, specifications, and resources needed to develop a public health emergency contact center that is highly integrated with public health agencies. The report is available on the Bioterrorism Preparedness section of the AHRQ Web site (<http://www.ahrq.gov/research/health/health.pdf>), as is the HEALTH Contact

Center Assessment Tool (<http://www.ahrq.gov/research/health/health.asp>). The Assessment Tool was developed to assist other agencies in developing the capabilities and functions of the *HEALTH Model*.

Discussion

The question and answer period included discussion of the PHS-CS, including time needed to deploy them and how they will be staffed. Staffing of Medical Call Centers was also discussed.

Public Health Service Contingency Stations

Dr. Claypool explained that the time required to deploy the PHS-CS is expected to evolve as the Stations themselves are developed in stages and as they are procured in greater numbers. The initial set of four Stations that were purchased in 2004 were tested in late 2004 and early 2005. The component parts of these Stations are palletized and are designed to be set up in a facility such as a high school gymnasium. Dr. Claypool estimated that, initially, response to a medical event might take 24 to 48 hours.

The goal of the PHS-CS program over the next few years is to place the Stations in ready positions all around the country, in each of the Federal Emergency Management Agency's Health Emergency Service Regions. The corresponding goal is to be able to deploy one or more of the Stations in a matter of hours. Dr. Claypool gave the example of having to quarantine the passengers on a 747 jet at an airport: Rather than hold the passengers on the airplane, parked on the tarmac for 24 or 48 or 72 hours, the target would be to set up a 250-bed Contingency Station with its quarantine capability in a hangar at the affected airport in as few as 4 hours.



The staffing of a Contingency Station is separate from its physical components. Dr. Claypool said that the basic unit, that is, a 50-bed module that has medical service ward capability, would require two doctors who would be supported by physician's assistants, registered nurses, medical technicians, and some administrative staff. The total would be 20 or more qualified staff members.

In response to a question about the relationship between DMATs and the PHS-CS, Dr. Claypool said it is likely that both would be activated in response to a major event, and they would be expected to work in concert and to coordinate with each other.

Regarding both time to deploy and the number of staff needed, Dr. Shannon cited his experience as a member of one of the Pediatric DMATs. He said that the actual transport time to get the Children's Hospital Boston team to the site of an emergency is "as quick as any type of plane ride you can imagine." More time is involved, however, in mobilizing the team, including contacting team members, and mobilizing their equipment. That mobilization can add many, many hours to the time for deployment, which is another argument for regionalization of Pediatric DMATs. The size of the Pediatric DMAT varies from 10 to 20 members, depending on the size of the emergency and whether or not that Pediatric DMAT team is incorporated into another DMAT team.

Dr. Claypool pointed out that the Contingency Stations will have pediatric capability, including pediatric formulations of drugs and pediatric beds.

Medical Call Centers

A question submitted by e-mail asked, "In the event that call centers are

utilized as a tool for mass casualty events and/or infectious disease outbreaks, what personnel will be used to support these call center infrastructures already in place?"

Assuming the surge of incoming calls would be more than regular staff could handle, "Where will the additional personnel come from? Volunteers? Public health people already in the organizations?"

Dr. Bogdan responded that the medical call centers have the technology infrastructure to handle large volumes of calls, "But we always come up short with personnel." He explained that additional personnel can be trained to perform limited functions, especially those such as setting up prepared answers to questions and helping the caller to understand the answers. His experience in Colorado has included considering pools of volunteers and establishing relationships with the Public Health Departments so they can supply personnel to help staff the phones. Another successful approach has been to use recorded messages that callers hear when they first connect with the call center. Those messages can be changed to reflect the information that is most commonly required at different points in time.

Dr. Bogdan cited his experience with the influenza outbreak in Colorado in 2003. Initially, the most common question was "Where can I get my shot?" Callers who asked that question could select from a menu of options that provided Web addresses containing information on locations in their neighborhoods where they could get their shot. The question most frequently asked then quickly became "What are the signs and symptoms of influenza?" The call center's message was changed to provide that information with the result that callers could learn what they wanted to

know without necessarily having to be connected to a live human being.

For More Information

The Web conference on which this issue brief is based, "Addressing Surge Capacity in a Mass Casualty Event," is available as a streaming presentation and as a text transcript on the Bioterrorism Preparedness section of AHRQ's Web site (<http://www.ahrq.gov/news/ulp/btsurge/mass/>).

Several resources on health system preparedness for bioterrorism have been developed with funding from AHRQ and are available on the AHRQ Web site. *The Rocky Mountain Regional Care Model for Bioterrorist Events* (<http://www.ahrq.gov/research/altsites.htm>) presents information on alternative care facilities in response to a surge event and the personnel resources needed to staff those facilities.

To keep abreast of AHRQ-sponsored research, the availability of new tools, and other information relevant to surge capacity and bioterrorism preparedness, readers are encouraged to subscribe to AHRQ's Bioterrorism Preparedness LISTSERV. Instructions for subscribing can be found at <http://www.ahrq.gov/research/btpreplist.htm>

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